PATENT ABSTRACTS OF JAPAN

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(71)Applicant : TOYOTA MOTOR CORP

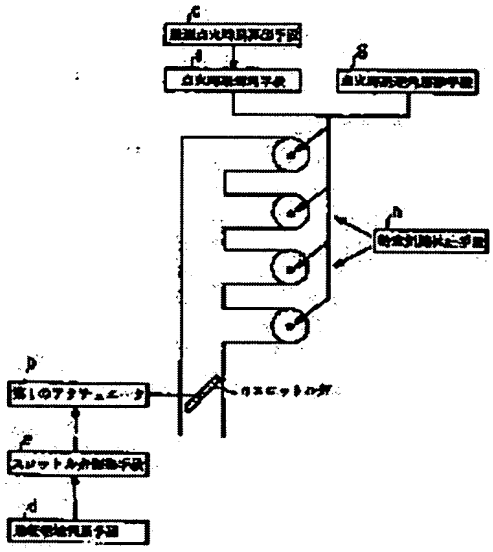
(72)Inventor : HARADA KENICHI

(54) PARTIAL OPERATION CONTROL DEVICE OF ENGINE

(57)Abstract:

PURPOSE: To solve torque shortage caused when cylinder reducing operation is started by providing such means as increasing the opening degree of a throttle valve, and also delaying an ignition timing, when operating range is transferred from all cylinder operating range to cylinder reducing operating range.

CONSTITUTION: The cylinder of an engine is divided into a plurality of pairs, and it is separately operated so as to stop operation of the cylinder in a specified pair. In this case, a throttle valve (a) is driven by an actuator (b). On the other hand, the optimal ignition timing of the engine is calculated by a means (c). It is judged by a means (d) whether operating condition of the engine is in an all cylinder operating range or a cylinder reducing operating range. As a result, when it is judged that it is in the cylinder reducing operating range at the time of all cylinder operation, the throttle valve (a) is controlled by a means (e) so as to increase the opening degree thereof. Simultaneously, an ignition timing is delayed by a means (f) so as to suppress increasing of an engine torque. After lapse of the prescribed time, the delay angle of the ignition timing is released by a means (g) and also operation of the cylinder in the specified pair is stopped by a means (h).



LEGAL STATUS

[Date of request for examination]	11.09.1997
[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3044919
[Date of registration]	17.03.2000
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[Date of extinction of right]	

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention divides a gas column into two or more groups, and relates to what fully controls the torque fluctuation at the time of outage initiation of a specific gas column especially about the division control device of the engine whose pause of the gas column of the specific group decided beforehand was enabled.
[0002]
[Description of the Prior Art] It is better for thermal efficiency to operate with a heavy load generally, rather than an engine is no-load and it operates. Therefore, when an engine load is low, the engine of the division operation controlling expression which stopped operation of a specific gas column, operated in the remaining gas columns, raised the load per gas column, and raised thermal efficiency as a whole is developed. For example, conventional equipment which is indicated by JP,62-103430,A As opposed to the accelerator opening same since fluctuation arises at engine generating torque in the time of the start up of a specific gas column, and operation relaxation time, in order to control this torque fluctuation at the time of specific gas column operation The opening of a throttle valve is controlled to become smaller than the opening of the throttle valve of specific gas column operation relaxation time. Conversely specific gas column operation relaxation time By the time of operation of a specific gas column, and operation relaxation time, throttle opening is controlled by controlling the opening of a throttle valve to become larger than the opening of the throttle valve at the time of specific gas column operation so that engine generating torque becomes equal.
[0003]
[Problem(s) to be Solved by the Invention] However, like an above-mentioned technique, only by controlling a throttle valve to the operation relaxation time of a specific gas column to become larger than the opening of the throttle valve at the time of specific gas column operation, the inhalation air content corresponding to the throttle opening is not acquired, but an engine torque falls temporarily and cannot finish suppressing result torque fluctuation immediately after at the time of specific gas column outage initiation. This phenomenon is explained using drawing 3 . In drawing 3 (A), if it changes from all gas column operating range to a reduced-cylinder operation field at time of day t1 during [all] gas column operation, reduced-cylinder operation will be started at the same time whenever [throttle valve-opening] is controlled to become larger than whenever [present throttle valve-opening] (refer to the continuous line of drawing 3 (B)). (Refer to drawing 3 (D)) However, as drawing 3 (E) shows, an engine torque falls temporarily after time-of-day t1, and is converged on the engine torque at the time of all gas column operations at time of day t2. Even if this phenomenon performs open control so that it may become whenever [target throttle valve-opening] about a throttle valve, and it serves as whenever [target throttle valve-opening], since an inhalation air content required at the time-of-day t2 time is acquired as it is not immediately obtained but is shown by the broken line of drawing 3 (B), at this time (time-of-day t1+alpha of drawing 3 (B)), the inhalation air content corresponding to that opening is generated for the change delay of an inhalation air content.
[0004] This invention was not made paying attention to such a problem, and aims at an engine torque not falling temporarily at the time of outage initiation of a specific gas column, and controlling

generating of the torque fluctuation immediately after the start up of a specific gas column.
[0005]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem the division control device of the engine of this invention In the division control device of the engine whose pause of operation of the gas column of the specific group which divided the gas column into two or more groups, and was decided beforehand was enabled The 1st actuator which carries out the closing motion drive of the throttle valve, and an optimal ignition timing calculation means to compute the optimal ignition timing corresponding to engine operational status, A operating-range decision means to judge whether engine operational status is in all gas column operating range or a reduced-cylinder operation field, If it is judged as a reduced-cylinder operation field with this operating-range decision means at the time of all gas column operations So that a throttle valve-opening indication signal may be outputted to said 1st actuator and increase of the engine torque accompanying increase may be inhibited whenever [by throttle valve-control means to increase throttle opening, and this throttle valve-control means / throttle valve-opening] An ignition timing lag means to delay ignition timing rather than the optimal ignition timing, and an ignition timing lag discharge means to cancel said ignition timing lag control when predetermined time progress is carried out, after said throttle opening turns into predetermined opening, It is characterized by having a specific gas column pause means to stop operation of the gas column of the specific group beforehand decided to be discharge and coincidence of this lag control.
[0006]
[Function] This operation is explained using drawing 4 . First, open control of a throttle valve is performed by the 1st actuator based on the output signal which will be outputted from a throttle valve-control means if it judges that it changed with operating-range decision means at time of day t1 during all gas column operation in drawing 4 (A) to the reduced-cylinder operation field from all the gas column operating range, and it becomes larger than whenever [throttle valve-opening / of the present / whenever / throttle valve-opening] (refer to drawing 4 (B)). Yet, reduced-cylinder operation is not started at this time (refer to drawing 4 (D)). However, if throttle opening is enlarged with all gas column operational status, the engine torque is lighting ignition timing by shifting with an ignition timing lag means at the lag side rather than the optimal ignition timing called for by the optimal ignition timing calculation means, in order to control the increment in this engine torque, since it increases. (Refer to drawing 4 (C) and drawing 4 (E)) . Then, as shown by the broken line of drawing 4 (B), after becoming predetermined opening by time-of-day t1'+alpha, it is at the time-of-day t2 time after a certain time amount progress (in other words). a required inhalation air content obtains -- having -- an engine-torque difference -- the time of all gas column operations and reduced-cylinder operation -- zero -- becoming -- reduced-cylinder operation is performed by the specific gas column pause means, and lag control of ignition timing is canceled by the ignition timing lag discharge means (refer to drawing 4 (C) and drawing 4 (D)). That is, lag control of the ignition timing is carried out only for the predetermined time equivalent to time-of-day t2' from time-of-day t1'.
[0007]
[Example] Hereafter, this example is explained using a drawing. Drawing 2 shows arrangement of the whole division control device of the engine of the 1st example. 1 -- an engine -- it is -- an engine 1 -- the right-hand side from the left-hand side of drawing 2 -- turning -- the 1- have the 4th four gas column, inlet manifolds 2a-2d and exhaust manifolds 3a-3d are connected to this each gas column, respectively, the upper limit which is these inlet manifolds 2a-2d is connected to the inhalation-of-air path 2, and the these exhaust manifolds [3a-3d] lower limit is connected to the flueway 3, respectively. The 1st - the 4th fuel injection valve 4a-4d are formed in each inlet manifolds 2a-2d. Moreover, the throttle sensor 9 which detects the air cleaner 5 for taking in atmospheric air, the air flow meter 6 for detecting the flow rate of the inhalation air adopted by the inhalation-of-air path 2 with this air cleaner 5, the throttle valve 8 for controlling the flow rate of the inhalation air which is interlocked with the throttle actuator 7, and was opened and closed, and the opening of a throttle valve 8 is formed in the upstream of the inhalation-of-air path 2. In addition, in the case of this example, the throttle sensor 9 has detected engine loaded condition. The accelerator pedal 13 is connected with the throttle valve 8 by the well-known link mechanism. Moreover, the accelerator

pedal opening sensor 14 which detects accelerator pedal opening is formed in the accelerator pedal 13. The ignition 10 consists of an ignitor and an ignition coil (both illustration abbreviation). By being prepared for the distributor 11 and detecting rotation of a distributor shaft (illustration abbreviation), crank angle sensor 11a and criteria location sensor 11b detect the signal for every 30-degree rotation of a crankshaft (illustration abbreviation) in crank angle sensor 11a, and detect the top dead center of the 1st gas column by criteria location sensor 11b. In addition, crank angle sensor 11a has accomplished the engine speed sensor. The control device 12 is equipped with RAM(random access memory)12e by which the data inputted into an electronic control circuit as input circuit 12a which changes an input signal into a digital signal etc., CPU(central processing unit)12b as arithmetic and program control, output circuit 12c, and ROM(lead-on memory)12d in which a control program and an initial data are stored as an internal circuitry, and data required for operation control are written temporarily. A signal, the inhalation air content detection value from an air flow meter 6, and the accelerator opening signal from the accelerator opening sensor 14 are inputted into said input circuit 12a whenever [from the throttle sensor 9 / rotational frequency detection value / from crank angle sensor 11a / top dead center signal / of the predetermined gas column from criteria location sensor 11b /, and throttle valve-opening]. Closing motion control of a throttle valve 8, fuel-injection control, and ignition timing control are performed by each output signal from said output circuit 12c computed based on each data inputted into said input circuit 12a. the optimal ignition timing value (the ignition timing for generating the maximum torque -- a tooth-lead-angle value --) corresponding to an engine speed and an inhalation air content in ignition timing control And ROM12d in a control unit 12 is made to memorize beforehand a criteria location including a lag value, for example, the include angle from a top dead center. Whenever the reference phase signal from criteria location sensor 11a is given, the optimal ignition timing corresponding to the engine speed (from an include-angle signal to calculation) and inhalation air content at that time is read from ROM12d in a control unit 12, and ignition timing is sent out when a gas column is an inhalation process or just before [its]. By this ignition signal, the high voltage occurs in an ignition coil 10, and ignition is performed. Moreover, corresponding to the operational status of the engine by the combination of the arbitration of the engine speed of accelerator opening and an engine, the field data divided into the reduced-cylinder operation (low loading) field and all the gas column operation (heavy load) fields which were beforehand called for by experiment are stored in ROM12d.

[0008] Next, drawing 5 explains the routine for performing reduced-cylinder operation from all gas column operations. In addition, this routine is performed for every predetermined time by CPU12b as arithmetic and program control which is a part of internal circuitry of a control unit 12. When it goes into this routine first, in step 100, it is based on current accelerator opening and an engine rotational frequency. It corresponds to the operational status of the engine by the combination of the arbitration of the engine speed of the accelerator opening beforehand memorized by ROM12d in a control device 12, and an engine. A judgment of all gas column operating range or a reduced-cylinder operation field is made with the field data divided into the reduced-cylinder operation (low loading) field and all the gas column operation (heavy load) fields which were called for by experiment. If judged as a reduced-cylinder operation field (YES) at step 100, it will progress to step 101 and will judge whether reduced-cylinder operation is performed. If it is judged as (NO) during [all] gas column operation at step 101, it will progress to step 102 and whenever [** valve-opening / target throttle] will be computed based on current accelerator opening and an engine rotational frequency at the time of the reduced-cylinder operation shift called for by experiment in the combination of the arbitration of the rotational frequency of the accelerator opening beforehand memorized by ROM12d in a control device 12, and an engine. At continuing step 103, open control of the throttle valve 8 is carried out with the throttle actuator 7 based on the output signal outputted from a control device 12 so that it may become whenever [** valve-opening / target throttle] at the time of the reduced-cylinder operation shift computed at step 102. At continuing step 104, the throttle sensor 9 detects whenever [current throttle valve-opening], and it judges whether whenever [** valve-opening / target throttle] was reached at the time of the reduced-cylinder operation shift by which whenever [throttle valve-opening / which was detected] was computed at step 102. When whenever [current throttle valve-opening] is judged to be (NO) which has not reached whenever [** valve-opening / target throttle] at the time of reduced-cylinder operation shift at step 104, the

amount of ignition timing lags which controls the increment in the engine torque corresponding to step 108 HE progress and the current increment in an inhalation air content is computed. For example, a difference with the inhalation air content which was made to memorize the inhalation air content at the time of it being judged first that it shifted to the reduced-cylinder operation field, and was memorized at the beginning at the time of a current inhalation air content and reduced-cylinder operation shift is searched for, and the amount of lags according to this difference is computed from the amount map of lags memorized by ROM12d in a control unit 12. At continuing step 109, based on the amount of ignition timing lags computed at step 108, only the value corresponding to a fixed include angle or an ignition timing value delays ignition timing from the optimal ignition timing value, and this routine is ended. Moreover, at continuing step 105, if whenever [current at step 104 throttle valve-opening] is judged to have reached whenever [** valve-opening / target throttle] at the time of reduced-cylinder operation shift (YES), after whenever [current throttle valve-opening] reaches whenever [** valve-opening / target throttle] at the time of reduced-cylinder operation shift, it will judge whether predetermined time progress was carried out. That is, it judges whether it became the actual inhalation air content from which a current inhalation air content is absorbed by whether predetermined time progress was carried out by whenever [** valve-opening / target throttle] at the time of reduced-cylinder operation shift. Since a setup of predetermined time changes with engine setup, conditions, etc., it should just make ROM12d in a control unit 12 memorize the data beforehand called for by experiment. In addition, after being judged as a reduced-cylinder operation field instead of steps 104 and 105 at the time of all gas column operations, you may judge by whether predetermined time progress was carried out. At step 105, when it is judged that predetermined time progress is not carried out, step 108 and step 109 which were mentioned above are performed, and this routine is ended. Moreover, by step 105, if it is judged that predetermined time progress was carried out (YES), at step 106, generating of the injection pulse signal added to fuel injection valves 4b and 4c will be stopped, and a No. 2 gas column and a No. 3 gas column will be made into operation hibernation. (This condition is called under reduced-cylinder operation.) At continuing step 107, immediately after starting reduced-cylinder operation, lag control of ignition timing is canceled and this routine is ended. Moreover, if judged as (NO) which is not a reduced-cylinder operation field (namely, all gas column operating range) at step 100, it will progress to step 110 and whenever [all / that was called for by experiment in the combination of the arbitration of the rotational frequency of the accelerator opening beforehand memorized by ROM12d in a control device 12 and an engine / for gas columns / target throttle valve-opening] will be computed based on current accelerator opening and an engine rotational frequency. At continuing step 111, based on the output signal outputted from a control device 12, open control of the throttle valve 8 is carried out with the throttle actuator 7 so that it may become whenever [all / that was computed at step 110 / for gas columns / target throttle valve-opening], and this routine is ended. Moreover, at step 101, if judged as under reduced-cylinder operation (YES), it will progress to step 112 and whenever [for **** / target throttle valve-opening / which was called for by experiment in the combination of the arbitration of the rotational frequency of the accelerator opening beforehand memorized by ROM12d in a control device 12 and an engine] will be computed based on current accelerator opening and an engine rotational frequency. At continuing step 113, based on the output signal outputted from a control device 12, open control of the throttle valve 8 is carried out with the throttle actuator 7 so that it may become whenever [for **** / target throttle valve-opening / which was computed at step 112], and this routine is ended.

[0009] The increment in an engine torque is controlled by carrying out lag control of the ignition timing, since an engine torque will increase inevitably if throttle valve-opening control is performed with all gas column operation, although a throttle valve is controlled in the open direction to become whenever [first required at time of reduced-cylinder operation target throttle valve-opening] if it becomes a reduced-cylinder operation field from all the gas column operating range in this example as explained above. After reaching whenever [target throttle valve-opening] by throttle valve-opening control, it is after predetermined time progress (in other words). By the actually required inhalation air content having been securable, namely, performing reduced-cylinder operation, when [this] an engine-torque difference becomes zero in the time of all gas column operations and reduced-cylinder operation, and canceling lag control of ignition timing to activation and

coincidence of this reduced-cylinder operation If the engine torque generated at the time of all gas column operations is obtained from immediately after reduced-cylinder operation initiation, it will become **, and the lack of torque which takes place at the time of reduced-cylinder operation initiation can be canceled.
[0010] As mentioned above, although the example has been explained based on a drawing, a concrete configuration is not restricted to this example, and even if there is a design in the range which does not deviate from the summary of this invention etc., it is included in this invention.
[0011] For example, although only fuel injection was suspended in the example when performing reduced-cylinder operation, ignition may also be stopped to coincidence.
[0012]
[Effect of the Invention] If it becomes a reduced-cylinder operation field from all gas column operating range, a throttle valve will be controlled by this invention in the open direction to become whenever [required at time of reduced-cylinder operation target throttle valve-opening] first. If this throttle valve-opening control is performed, after controlling the rise of an engine torque started inevitably by ignition timing lag control and reaching whenever [target throttle valve-opening] by throttle valve-opening control, it is after predetermined time progress (in other words). By the actually required inhalation air content having been securable, namely, performing reduced-cylinder operation, when [this] an engine-torque difference becomes zero in the time of all gas column operations and reduced-cylinder operation, and canceling lag control of ignition timing If the engine torque generated at the time of all gas column operations is obtained from immediately after reduced-cylinder operation initiation, it will become **, and the lack of torque which takes place at the time of reduced-cylinder operation initiation can be canceled.

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CLAIMS

[Claim(s)]
[Claim 1] In the division control device of the engine whose pause of operation of the gas column of the specific group which divided the gas column into two or more groups, and was decided beforehand was enabled The 1st actuator which carries out the closing motion drive of the throttle valve, and an optimal ignition timing calculation means to compute the optimal ignition timing corresponding to engine operational status, A operating-range decision means to judge whether engine operational status is in all gas column operating range or a reduced-cylinder operation field, If it is judged as a reduced-cylinder operation field with this operating-range decision means at the time of all gas column operations So that a throttle valve-opening indication signal may be outputted to said 1st actuator and increase of the engine torque accompanying increase may be inhibited whenever [by throttle valve-control means to increase throttle opening, and this throttle valve-control means / throttle valve-opening] An ignition timing lag means to delay ignition timing rather than the optimal ignition timing, and an ignition timing lag discharge means to cancel said ignition timing lag control when predetermined time progress is carried out, after said throttle opening turns into predetermined opening, The division control device of the engine characterized by having a specific gas column pause means to stop operation of the gas column of the specific group beforehand decided to be discharge and coincidence of this lag control.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of invention.
[Drawing 2] General drawing of an engine division control device.
[Drawing 3] The timing diagram at the time of division operation actuation (former).
[Drawing 4] The timing diagram at the time of division operation actuation (this example).
[Drawing 5] The flow chart at the time of division operation activation.
[Description of Notations]
... Throttle valve
b ... The 1st actuator
c ... Optimal ignition timing detection means
d ... Operating-range decision means
e ... Throttle valve-control means
f ... Ignition timing lag means
g ... Ignition timing lag discharge means
h ... Specific gas column pause means
1 ... Engine
2 ... Inhalation-of-Air Path
2 a-d .. Inlet manifold
3 ... Flueway
3 a-d .. Exhaust manifold
4 a-d .. Fuel injection valve
5 ... Air Cleaner
6 ... EFUFU Low Meter
7 ... Throttle Actuator
8 ... Throttle Valve
9 ... Throttle Sensor
10 ... Ignition
11a ... Criteria location sensor
11b ... Crank angle sensor
12 ... Control Unit
12a ... Input circuit
12 b...CPU
12c ... Output circuit
12d ... ROM
12 e...RAM
13 ... Accelerator Pedal
14 ... Accelerator Pedal Opening Sensor

[Translation done.]

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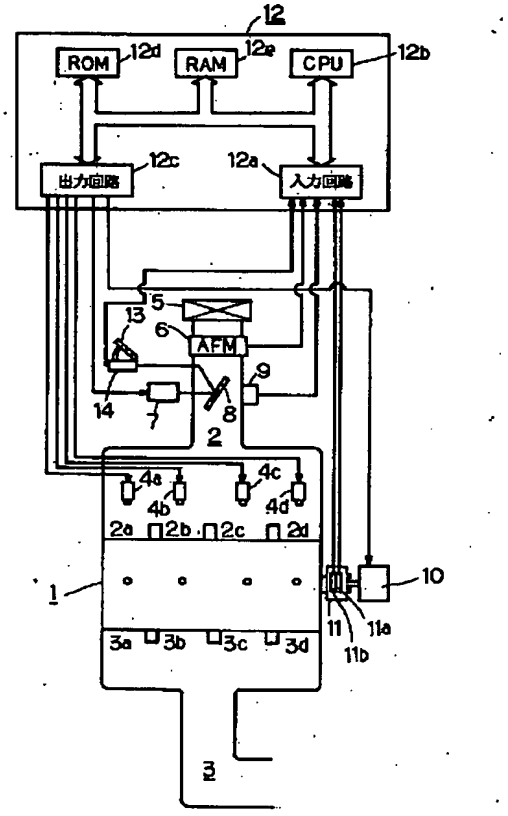
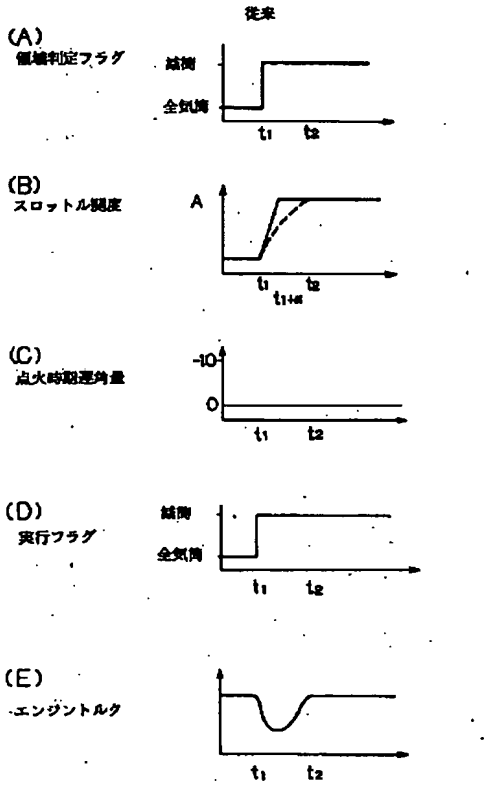
DRAWINGS

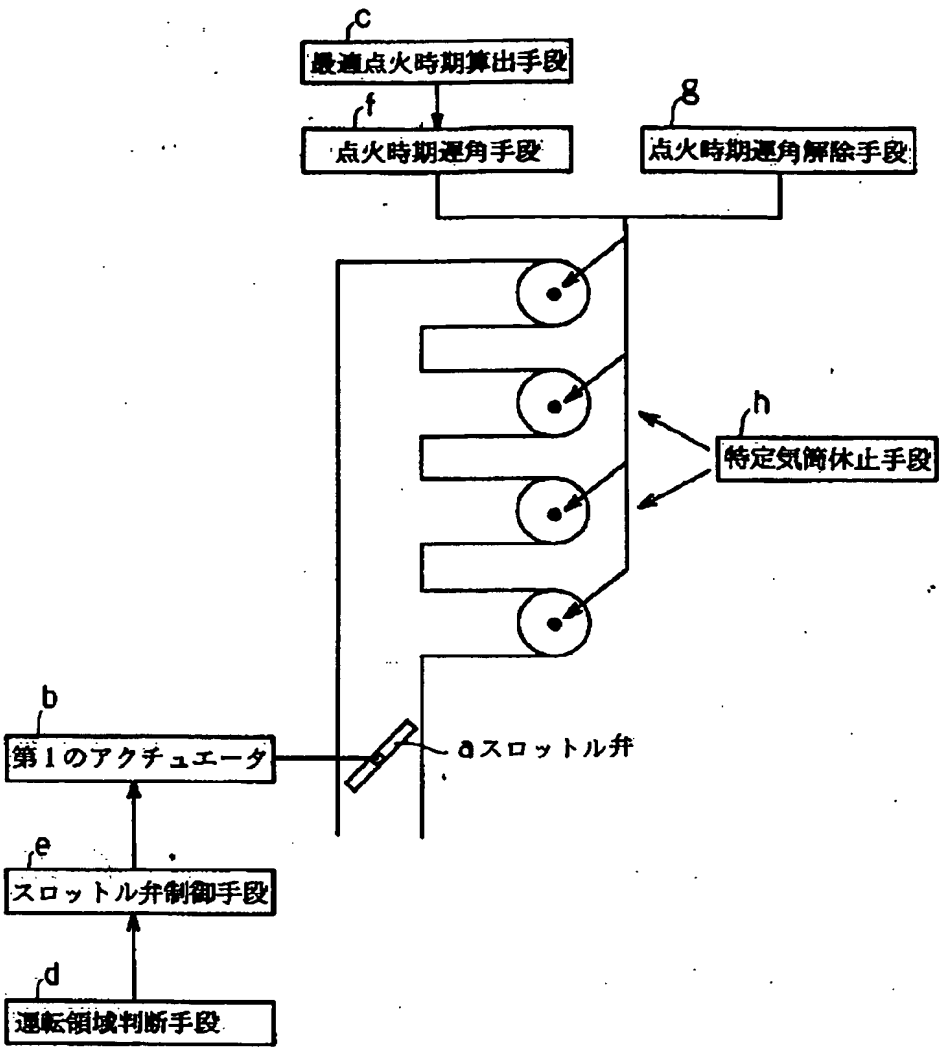
[Drawing 2]



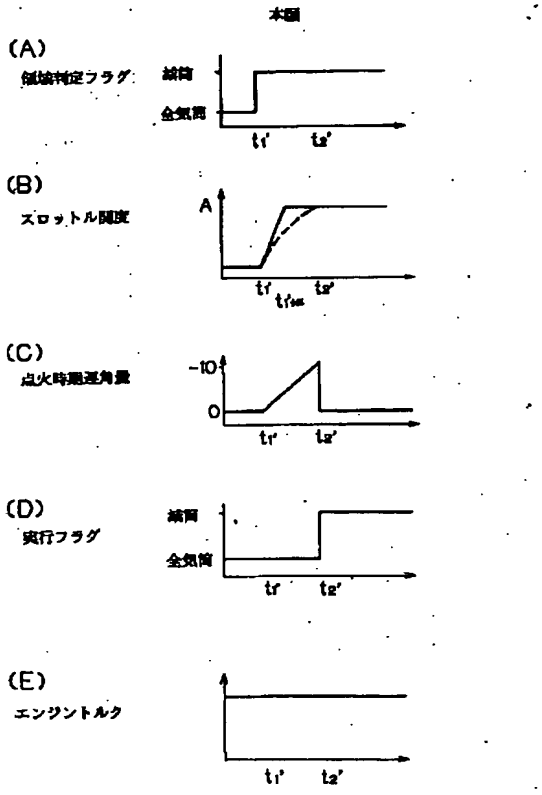
[Drawing 3]



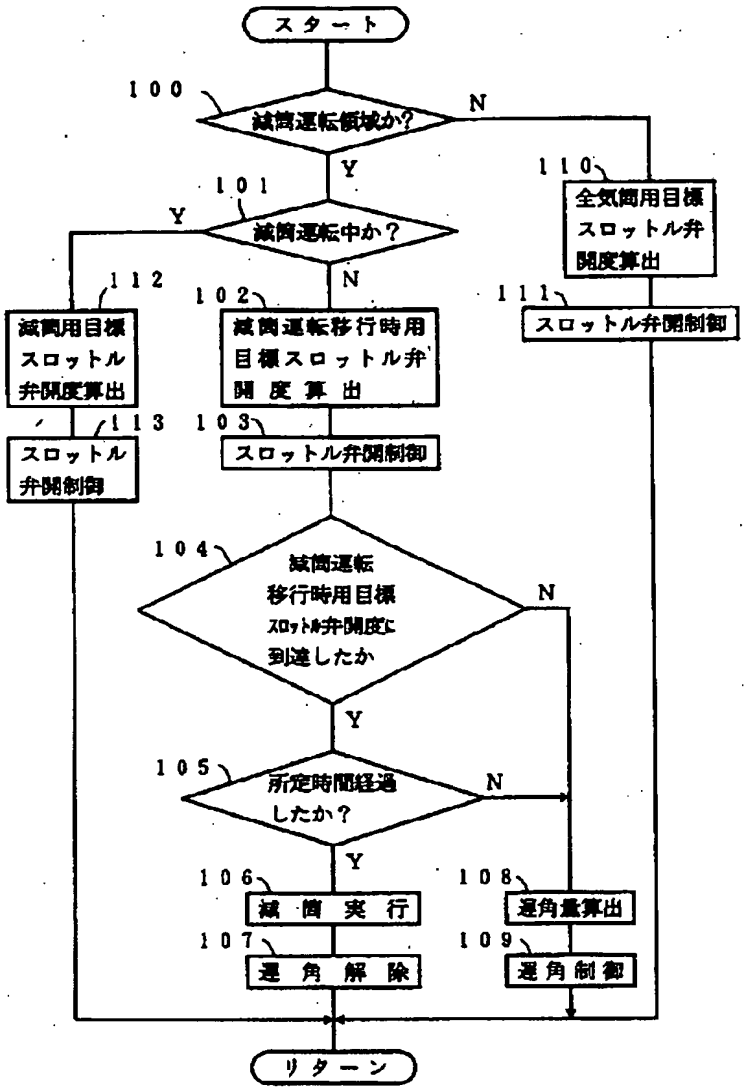
[Drawing 1]


c
最適点火時期算出手段
f
点火時期遅角手段
g
点火時期遅角解除手段
h
特定気筒休止手段
b
第1のアクチュエータ
aスロットル弁
e
スロットル弁制御手段
d
運転領域判断手段

[Drawing 4]



[Drawing 5]



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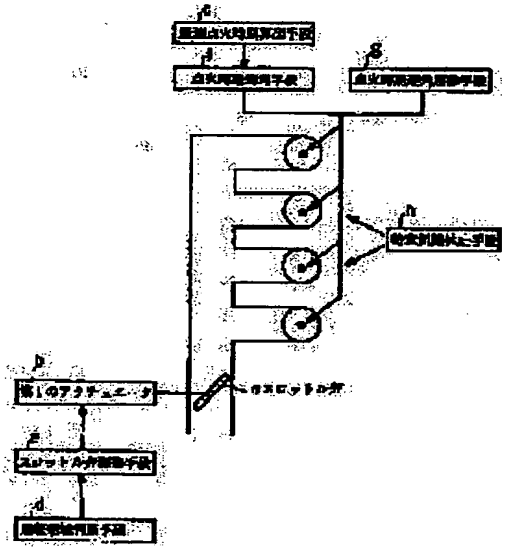
(72)Inventor : HARADA KENICHI

(54) PARTIAL OPERATION CONTROL DEVICE OF ENGINE

(57)Abstract:
PURPOSE: To solve torque shortage caused when cylinder reducing operation is started by providing such means as increasing the opening degree of a throttle valve, and also delaying an ignition timing, when operating range is transferred from all cylinder operating range to cylinder reducing operating range.
CONSTITUTION: The cylinder of an engine is divided into a plurality of pairs, and it is separately operated so as to stop operation of the cylinder in a specified pair. In this case, a throttle valve (a) is driven by an actuator (b). (b). On the other hand, the optimal ignition timing of the engine is calculated by a means (c). It is judged by a means (d) whether operating condition of the engine is in an all cylinder operating range or a cylinder reducing operating range. As a result, when it is judged that it is in the cylinder reducing operating range at the time of all cylinder operation, the throttle valve (a) is controlled by a means (e) so as to increase the opening degree thereof. Simultaneously, an ignition timing is delayed by a means (f) so as to suppress increasing of an engine torque. After lapse of the prescribed time, the delay angle of the ignition timing is released by a means (g) and also operation of the cylinder in the specified pair is stopped by a means (h).



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9/02		B		
41/02	330	C 7813－3G		

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(22)出願日　平成4年(1992)5月28日

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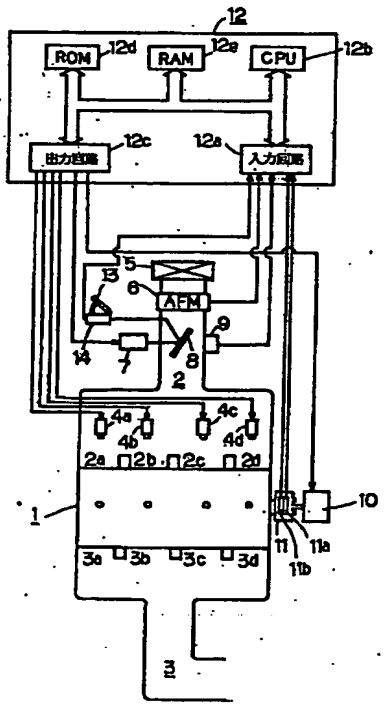
最終頁に続く

(54)【発明の名称】エンジンの分割運転制御装置

(57)【要約】
【目的】全気筒運転から減筒運転を行うときにおこるエンジントルクの低下を防止する。
【構成】全気筒運転中にエンジンの運転領域が全気筒運転領域から減筒運転領域へ移行されると、全気筒運転状態のままスロットル弁開度は現在のスロットル弁開度よりも大きくなるように開制御される。この時点では、減筒運転が実行されていないのでスロットル弁開制御に伴うエンジントルクの増加を点火時期遅角制御にて抑制をする。その後、スロットル弁開制御により減筒運転時での目標スロットル開度になり、そのスロットル弁開度で得られる吸入空気量が実際に確保されると、減筒運転を実施し、点火時期遅角制御を解除することにより、減筒運転開始時に発生するエンジントルクの低下が防止される。



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【特許請求の範囲】

【請求項１】気筒を複数の組に分割し、予め決められた特定組の気筒の運転を休止可能としたエンジンの分割運転制御装置において、スロットル弁を開閉駆動する第１のアクチュエータと、エンジンの運転状態に対応した最適点火時期を算出する最適点火時期算出手段と、エンジンの運転状態が全気筒運転領域か減筒運転領域にあるか否かを判断する運転領域判断手段と、全気筒運転時に該運転領域判断手段により減筒運転領域と判断すると、前記第１のアクチュエータへスロットル弁開指示信号を出力し、スロットル開度を増大させるスロットル弁制御手段と、該スロットル弁制御手段によるスロットル弁開度増大に伴うエンジントルクの増大を抑止するよう、点火時期を最適点火時期よりも遅らせる点火時期遅角手段と、前記スロットル開度が所定開度となってから所定時間経過した場合に前記点火時期遅角制御を解除する点火時期遅角解除手段と、該遅角制御の解除と同時に予め決められた特定組の気筒の運転を休止する特定気筒休止手段とを備えることを特徴とするエンジンの分割運転制御装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、気筒を複数の組に分割し、予め決められた特定組の気筒を休止可能としたエンジンの分割運転制御装置に関し、特に、特定気筒の運転休止開始時のトルク変動を十分に抑制するものに関する。

【０００２】

【従来の技術】一般に、エンジンは無負荷で運転するよりも高負荷で運転した方が熱効率が良い。そのため、エンジン負荷が低い時には、特定気筒の運転を休止して、残りの気筒によって運転し、気筒当たりの負荷を高め、全体として熱効率を高めた分割運転制御式のエンジンが開発されている。例えば、特開昭６２－１０３４３０号公報に記載されているような従来の装置は、特定気筒の運転開始時および運転休止時にエンジンの発生トルクに変動が生じるので、このトルク変動を抑制するために、同じアクセル開度に対して、特定気筒運転時は、スロットル弁の開度を特定気筒運転休止時のスロットル弁の開度よりも小さくなるように制御し、逆に、特定気筒運転休止時は、スロットル弁の開度を特定気筒運転時のスロットル弁の開度よりも大きくなるように制御することで、特定気筒の運転時と運転休止時とで、エンジンの発生トルクが等しくなるようにスロットル開度を制御している。

【０００３】

【発明が解決しようとする課題】しかし、上述の技術の如く、特定気筒の運転休止時にスロットル弁を特定気筒運転時のスロットル弁の開度よりも大きくなるように制御するだけでは、特定気筒運転休止開始時直後では、そ

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のスロットル開度に対応した吸入空気量が得られずエンジントルクが一時低下して、結果トルク変動を抑えきれない。この現象を図３を用いて説明する。図３（Ａ）において、全気筒運転中に時刻ｔ１で全気筒運転領域から減筒運転領域に変化すると、スロットル弁開度は現在のスロットル弁開度よりも大きくなるように制御（図３（Ｂ）の実線参照）されると同時に減筒運転が開始される。（図３（Ｄ）参照）しかし、エンジントルクは図３（Ｅ）で示す如く時刻ｔ１以後一時低下し時刻ｔ２で全気筒運転時のエンジントルクに収束する。この現象は、スロットル弁を目標スロットル弁開度となるように開制御を行って、目標スロットル弁開度となっても、この時点（図３（Ｂ）の時刻ｔ１＋α）ではその開度に対応する吸入空気量はすぐには得られず図３（Ｂ）の破線で示される如く時刻ｔ２時点で必要な吸入空気量が得られるため、即ち、吸入空気量の変化遅れのために発生する。

【０００４】本発明は、このような問題に着目してなされたもので、特定気筒の運転休止開始時にエンジントルクが一時低下してしまうことがなく、特定気筒の運転開始直後のトルク変動の発生を抑制することを目的とする。

【０００５】

【課題を解決するための手段】上記課題を解決するために本発明のエンジンの分割運転制御装置は、気筒を複数の組に分割し、予め決められた特定組の気筒の運転を休止可能としたエンジンの分割運転制御装置において、スロットル弁を開閉駆動する第１のアクチュエータと、エンジンの運転状態に対応した最適点火時期を算出する最適点火時期算出手段と、エンジンの運転状態が全気筒運転領域か減筒運転領域にあるか否かを判断する運転領域判断手段と、全気筒運転時に該運転領域判断手段により減筒運転領域と判断すると、前記第１のアクチュエータへスロットル弁開指示信号を出力し、スロットル開度を増大させるスロットル弁制御手段と、該スロットル弁制御手段によるスロットル弁開度増大に伴うエンジントルクの増大を抑止するよう、点火時期を最適点火時期よりも遅らせる点火時期遅角手段と、前記スロットル開度が所定開度となってから所定時間経過した場合に前記点火時期遅角制御を解除する点火時期遅角解除手段と、該遅角制御の解除と同時に予め決められた特定組の気筒の運転を休止する特定気筒休止手段とを備えることを特徴とする。

【０００６】

【作用】本作用を図４を用いて説明する。まず、図４（Ａ）において、全気筒運転中に時刻ｔ１で運転領域判断手段により全気筒運転領域から減筒運転領域に変化したと判断すると、スロットル弁制御手段から出力される出力信号に基づいて第１のアクチュエータによりスロットル弁の開制御が行われ、スロットル弁開度は現在のスロットル弁開度よりも大きくなる（図４（Ｂ）参照）。

まだ、この時点では減筒運転は開始されない（図４（Ｄ）参照）。しかし、全気筒運転状態のままでスロットル開度を大きくするとエンジントルクは増加するため、このエンジントルクの増加を抑制するために、最適点火時期算出手段により求められた最適点火時期よりも点火時期を遅角側に点火時期遅角手段によりずらして点火を行っている。（図４（Ｃ）、図４（Ｅ）参照）。その後、図４（Ｂ）の破線で示される如く時刻ｔ1'＋αで所定開度となってから、ある時間経過後の時刻ｔ２時点（言い換えると、必要な吸入空気量が得られエンジントルク差が全気筒運転時と減筒運転時とでゼロになる）で、特定気筒休止手段により減筒運転が実行され、点火時期遅角解除手段により点火時期の遅角制御が解除される（図４（Ｃ）、図４（Ｄ）参照）。即ち、時刻ｔ１'から時刻ｔ２'に相当する所定時間だけ点火時期が遅角制御される。

【０００７】

【実施例】以下、図面を用いて本実施例について説明する。図２は、第１実施例のエンジンの分割運転制御装置全体の配置を示す。１はエンジンであり、エンジン１は図２の左側から右側に向けて第１～第４の４つの気筒を有し、該各気筒には吸気マニホールド２ａ～２ｄおよび排気マニホールド３ａ～３ｄがそれぞれ接続されており、該吸気マニホールド２ａ～２ｄの上端は吸気通路２に、該排気マニホールド３ａ～３ｄの下端は排気通路３にそれぞれ接続されている。各吸気マニホールド２ａ～２ｄには第１～第４の燃料噴射弁４ａ～４ｄが設けられる。また、吸気通路２の上流には、大気を取り入れるためのエアークリーナー５と、該エアークリーナー５により吸気通路２に取り入れられた吸入空気の流量を検出するためのエアフローメータ６と、スロットルアクチュエータ７と連動して開閉するようにされた吸入空気の流量を制御するためのスロットル弁８と、スロットル弁８の開度を検出するスロットルセンサ９が設けてある。なお、本実施例の場合、スロットルセンサ９によりエンジンの負荷状態を検出している。スロットル弁８には周知のリンク機構によりアクセルペダル１３が連結されている。また、アクセルペダル１３にはアクセルペダル開度を検出するアクセルペダル開度センサ１４が設けてある。点火装置１０は、イグナイタおよび点火コイル（共に図示省略）から構成されている。クランク角センサ１１ａおよび基準位置センサ１１ｂは、ディストリビュータ１１に設けられていて、ディストリビュータシャフト（図示省略）の回転を検出することによって、クランク角センサ１１ａではクランクシャフト（図示省略）の３０度回転毎の信号を検出し、基準位置センサ１１ｂでは第１の気筒の上死点を検出する。なお、クランク角センサ１１ａはエンジン回転数センサを成している。制御装置１２は、内部回路として、入力信号をデジタル信号等に変換する入力回路１２ａと、中央演算処理装置として

のＣＰＵ（セントラルプロセッシングユニット）１２ｂと、出力回路１２ｃと、制御プログラムおよび初期データが格納されるＲＯＭ（リードオンメモリ）１２ｄと、電子制御回路に入力されるデータや演算制御に必要なデータが一時的に読み書きされるＲＡＭ（ランダムアクセスメモリ）１２ｅを備えている。前記入力回路１２ａには、クランク角センサ１１ａからの回転数検出値と、基準位置センサ１１ｂからの所定気筒の上死点信号と、スロットルセンサ９からのスロットル弁開度信号と、エアフローメータ６からの吸入空気量検出値と、アクセル開度センサ１４からのアクセル開度信号とが入力される。前記入力回路１２ａに入力された各データに基づいて算出した前記出力回路１２ｃからの各出力信号により、スロットル弁８の開閉制御と、燃料噴射制御と、点火時期制御とが行われる。点火時期制御は、エンジン回転数と吸入空気量とに対応した最適点火時期値（最大トルクを発生するための点火時期で進角値、および遅角値を含む基準位置、例えば、上死点からの角度）を予め制御装置１２内のＲＯＭ１２ｄに記憶させておき、基準位置センサ１１ａからの基準位置信号が与えられる毎に、その時のエンジン回転数（角度信号から算出）と吸入空気量とに対応した最適点火時期を制御装置１２内のＲＯＭ１２ｄから読み出し、気筒が吸入工程またはその直前である時に点火時期を送出する。この点火信号によって点火コイル１０に高電圧が発生して点火が行われる。また、アクセル開度およびエンジンの回転数の任意の組み合わせによるエンジンの運転状態に対応して、実験により予め求められた減筒運転（低負荷）領域と全気筒運転（高負荷）領域とに分割した領域データがＲＯＭ１２ｄに格納されている。

【０００８】次に、図５により、全気筒運転から減筒運転を行うためのルーチンについて説明する。なお、このルーチンは、制御装置１２の内部回路の一部である中央演算処理装置としてのＣＰＵ１２ｂにより所定時間毎に実行される。まず本ルーチンに入ると、ステップ１００において、現在のアクセル開度およびエンジンの回転数に基づき、制御装置１２内のＲＯＭ１２ｄに予め記憶されているアクセル開度およびエンジンの回転数の任意の組み合わせによるエンジンの運転状態に対応して、実験により求められた減筒運転（低負荷）領域と全気筒運転（高負荷）領域とに分割した領域データにより全気筒運転領域か減筒運転領域かの判断が行われる。ステップ１００で減筒運転領域（ＹＥＳ）と判断されると、ステップ１０１へ進み減筒運転が実行されているか否かの判断を行う。ステップ１０１で全気筒運転中（ＮＯ）と判断されると、ステップ１０２へ進み、現在のアクセル開度とエンジンの回転数に基づき、制御装置１２内のＲＯＭ１２ｄに予め記憶されているアクセル開度およびエンジンの回転数の任意の組み合わせで実験により求められた減筒運転移行時用目標スロットル弁開度を算出する。続

くステップ１０３では、ステップ１０２で算出された減筒運転移行時用目標スロットル弁開度となるように制御装置１２より出力される出力信号に基づいてスロットルアクチュエータ７によりスロットル弁８を開制御する。続くステップ１０４では、現在のスロットル弁開度をスロットルセンサ９により検出し、その検出されたスロットル弁開度がステップ１０２で算出された減筒運転移行時用目標スロットル弁開度に到達したか否かを判断する。ステップ１０４で、現在のスロットル弁開度が減筒運転移行時用目標スロットル弁開度に到達していない（ＮＯ）と判断された場合は、ステップ１０８へ進み、現在の吸入空気量増加に対応したエンジントルクの増加を抑制する点火時期遅角量を算出する。例えば、減筒運転領域に移行されたと最初に判断された時点の吸入空気量を記憶させておき、現在の吸入空気量と減筒運転移行時当初に記憶された吸入空気量との差を求め、この差分に応じた遅角量を制御装置１２内のＲＯＭ１２ｄに記憶されている遅角量マップから算出する。続くステップ１０９では、ステップ１０８で算出された点火時期遅角量に基づき、点火時期を最適点火時期値から一定角度または点火時期値に対応した値だけ遅らせ、本ルーチンを終了する。また、ステップ１０４で現在のスロットル弁開度が減筒運転移行時用目標スロットル弁開度に到達した（ＹＥＳ）と判断されると、続くステップ１０５では、現在のスロットル弁開度が減筒運転移行時用目標スロットル弁開度に到達してから所定時間経過したか否かの判断を行う。即ち、所定時間経過したか否かにより現在の吸入空気量が減筒運転移行時用目標スロットル弁開度で吸い込まれる実際の吸入空気量になったか否かの判断をしている。所定時間の設定は、エンジンの設定および状態等により異なるため、予め実験により求められたデータを制御装置１２内のＲＯＭ１２ｄに記憶させておけばよい。なお、ステップ１０４、１０５に代わり全気筒運転時に減筒運転領域と判断されてから所定時間経過したか否かで判断してもよい。ステップ１０５で、所定時間経過しないと判断された場合は、前述したステップ１０８およびステップ１０９を実行して、本ルーチンを終了する。また、ステップ１０５で、所定時間経過した（ＹＥＳ）と判断されると、ステップ１０６では、燃料噴射弁４ｂ、４ｃに加える噴射パルス信号の発生を停止させ２番気筒および３番気筒を稼働休止状態にする。（この状態を減筒運転中という。）続くステップ１０７では、減筒運転が開始された直後に、点火時期の遅角制御を解除し、本ルーチンを終了する。また、ステップ１００で、減筒運転領域でない（即ち、全気筒運転領域）（ＮＯ）と判断されると、ステップ１１０へ進み、現在のアクセル開度とエンジンの回転数に基づき、制御装置１２内のＲＯＭ１２ｄに予め記憶されているアクセル開度およびエンジンの回転数の任意の組み合わせで実験により求められた全気筒用目標スロットル弁開度を算出する。

続くステップ１１１では、ステップ１１０で算出された全気筒用目標スロットル弁開度となるように制御装置１２より出力される出力信号に基づいてスロットルアクチュエータ７によりスロットル弁８を開制御し、本ルーチンを終了する。また、ステップ１０１で、減筒運転中（ＹＥＳ）と判断されると、ステップ１１２へ進み、現在のアクセル開度とエンジンの回転数に基づき、制御装置１２内のＲＯＭ１２ｄに予め記憶されているアクセル開度およびエンジンの回転数の任意の組み合わせで実験により求められた減筒用目標スロットル弁開度を算出する。続くステップ１１３では、ステップ１１２で算出された減筒用目標スロットル弁開度となるように制御装置１２より出力される出力信号に基づいてスロットルアクチュエータ７によりスロットル弁８を開制御し、本ルーチンを終了する。

【０００９】以上説明してきたように、本実施例では、全気筒運転領域から減筒運転領域になると、まず、減筒運転時に必要な目標スロットル弁開度となるようにスロットル弁を開方向に制御するが、全気筒運転のままスロットル弁開制御を行うと必然的にエンジントルクが増加するので、点火時期を遅角制御することによりエンジントルクの増加を抑制している。スロットル弁開制御により目標スロットル弁開度に到達してから所定時間経過後（言い換えると、実際に必要な吸入空気量が確保できた、即ち、エンジントルク差が全気筒運転時と減筒運転時とでゼロになる）、この時点で減筒運転が実行され、この減筒運転の実行と同時に点火時期の遅角制御を解除することにより、減筒運転開始直後から全気筒運転時に発生されていたエンジントルクが得られるとこになり、減筒運転開始時に起こるトルク不足を解消できる。

【００１０】以上、実施例を図面に基づいて説明してきたが、具体的な構成はこの実施例に限られるものでなく、本発明の要旨を逸脱しない範囲における設計等があっても本発明に含まれる。

【００１１】例えば、実施例では減筒運転を行う際に燃料噴射のみを停止したが、同時に点火も停止してもよい。

【００１２】

【発明の効果】本発明では、全気筒運転領域から減筒運転領域になると、まず、減筒運転時に必要な目標スロットル弁開度となるようにスロットル弁を開方向に制御する。このスロットル弁開制御を行うと必然的におこるエンジントルクの上昇を点火時期遅角制御で抑制し、スロットル弁開制御により目標スロットル弁開度に到達してから所定時間経過後（言い換えると、実際に必要な吸入空気量が確保できた、即ち、エンジントルク差が全気筒運転時と減筒運転時とでゼロになる）、この時点で減筒運転が実行され、点火時期の遅角制御を解除することにより、減筒運転開始直後から全気筒運転時に発生されていたエンジントルクが得られるとこになり、減筒運転開

始時に起こるトルク不足を解消できる。

【図面の簡単な説明】

【図１】　発明の構成図。

【図２】　エンジンの分割運転制御装置の全体図。

【図３】　分割運転作動時のタイムチャート（従来）。

【図４】　分割運転作動時のタイムチャート（本実施例）。

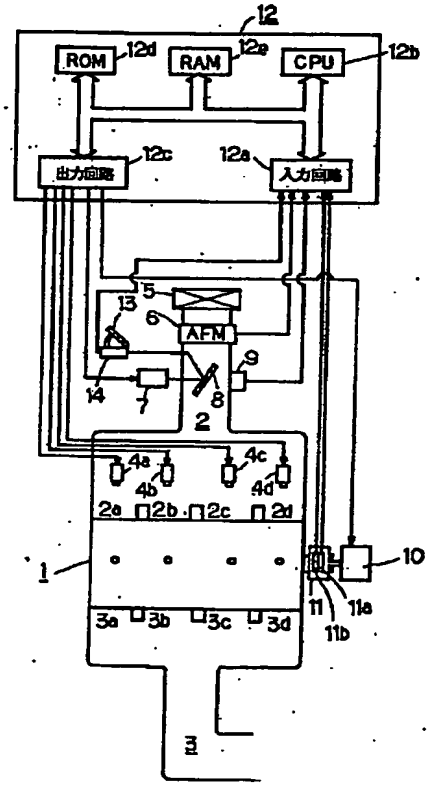
【図５】　分割運転実行時のフローチャート。

【符号の説明】

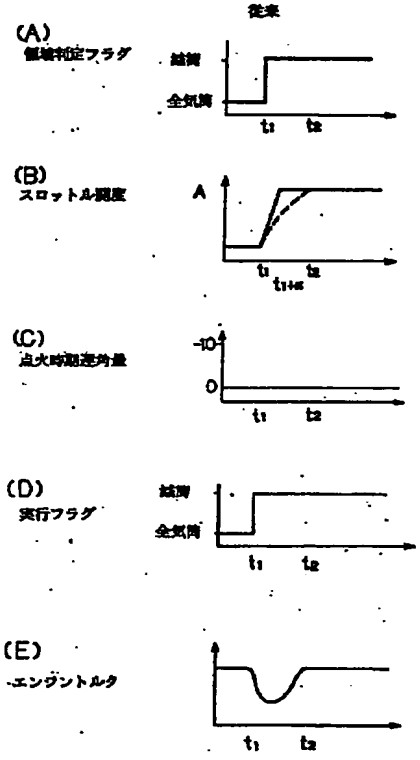
a　・・・スロットル弁
b　・・・第１のアクチュエータ
c　・・・最適点火時期検出手段
d　・・・運転領域判断手段
e　・・・スロットル弁制御手段
f　・・・点火時期遅角手段
g　・・・点火時期遅角解除手段
h　・・・特定気筒休止手段
1　・・・エンジン
2　・・・吸気通路
2 a～d・・吸気マニホールド

3　・・・排気通路
3 a～d・・排気マニホールド
4 a～d・・燃料噴射弁
5　・・・エアクリーナー
6　・・・エフフローメータ
7　・・・スロットルアクチュエータ
8　・・・スロットル弁
9　・・・スロットルセンサ
１０　・・・点火装置
１１a・・・基準位置センサ
１１b・・・クランク角センサ
１２　・・・制御装置
１２a・・・入力回路
１２b・・・ＣＰＵ
１２c・・・出力回路
１２d・・・ＲＯＭ
１２e・・・ＲＡＭ
１３　・・・アクセルペダル
１４　・・・アクセルペダル開度センサ

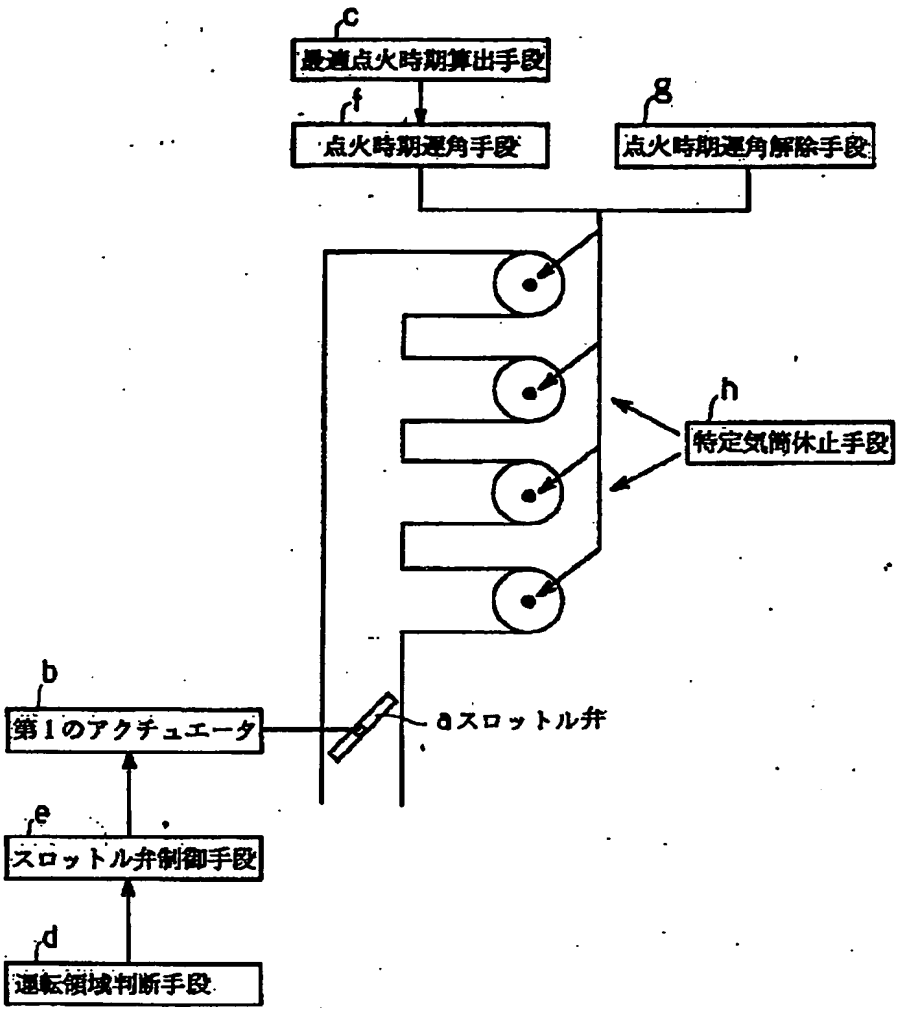
【図２】



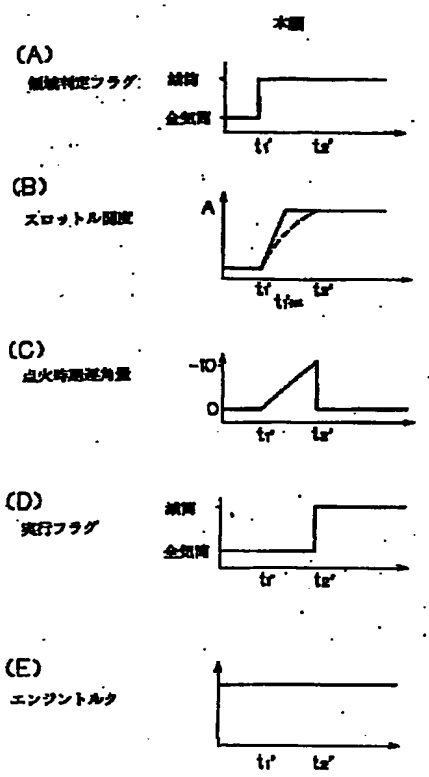
【図３】



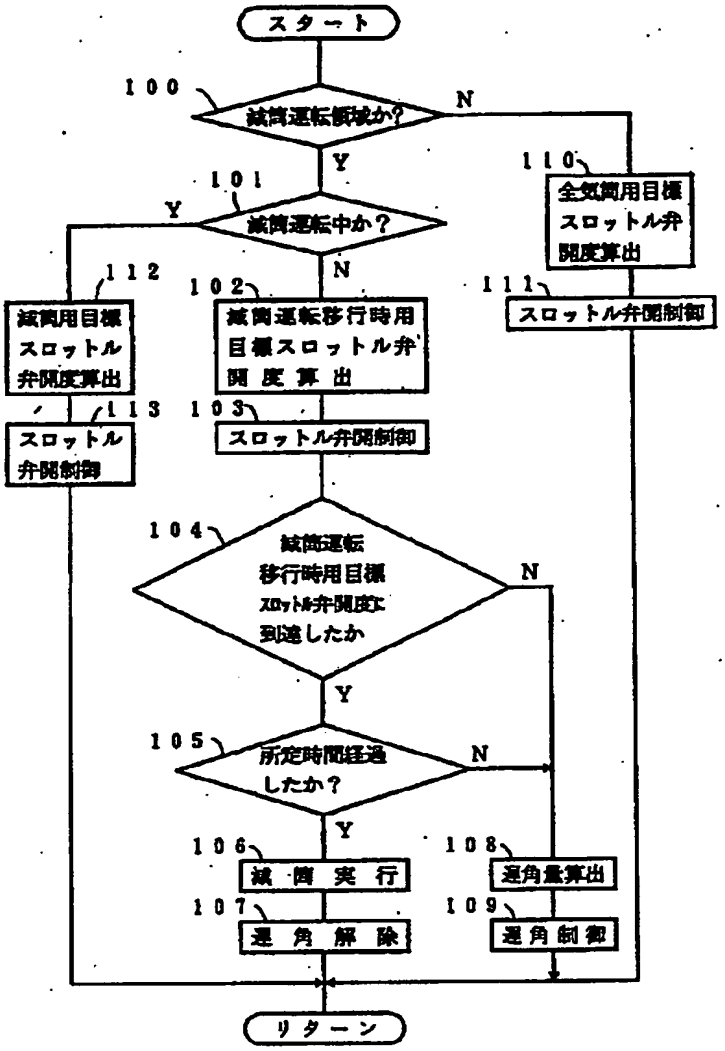
【図１】


c
最適点火時期算出手段
f
点火時期遅角手段
g
点火時期遅角解除手段
h
特定気筒休止手段
b
第１のアクチュエータ
aスロットル弁
e
スロットル弁制御手段
d
運転領域判断手段

【図４】



【図５】



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